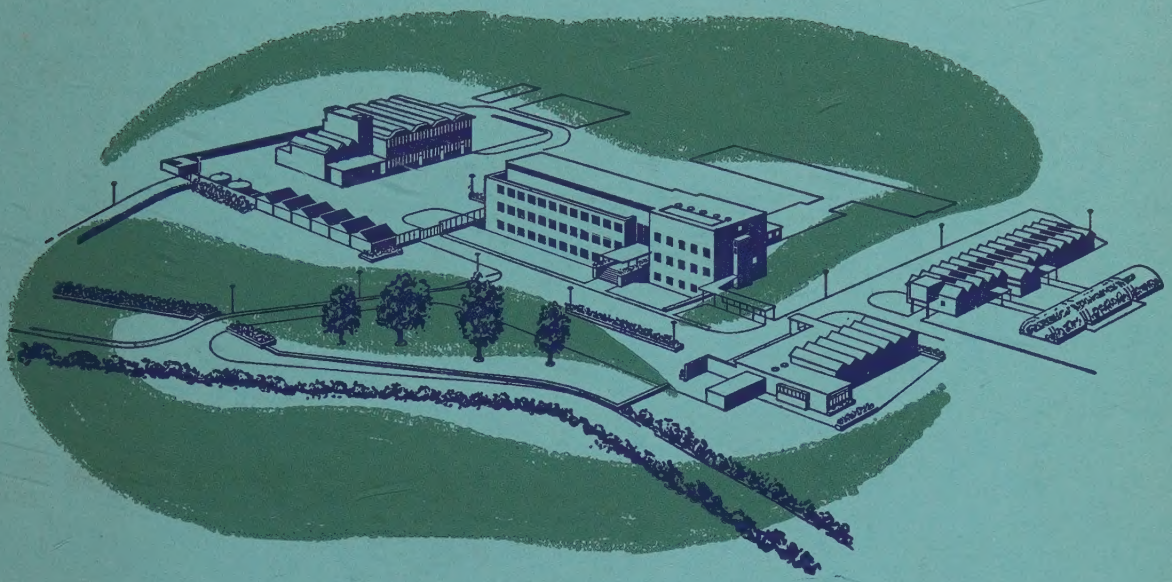


Levington Research Station

1958

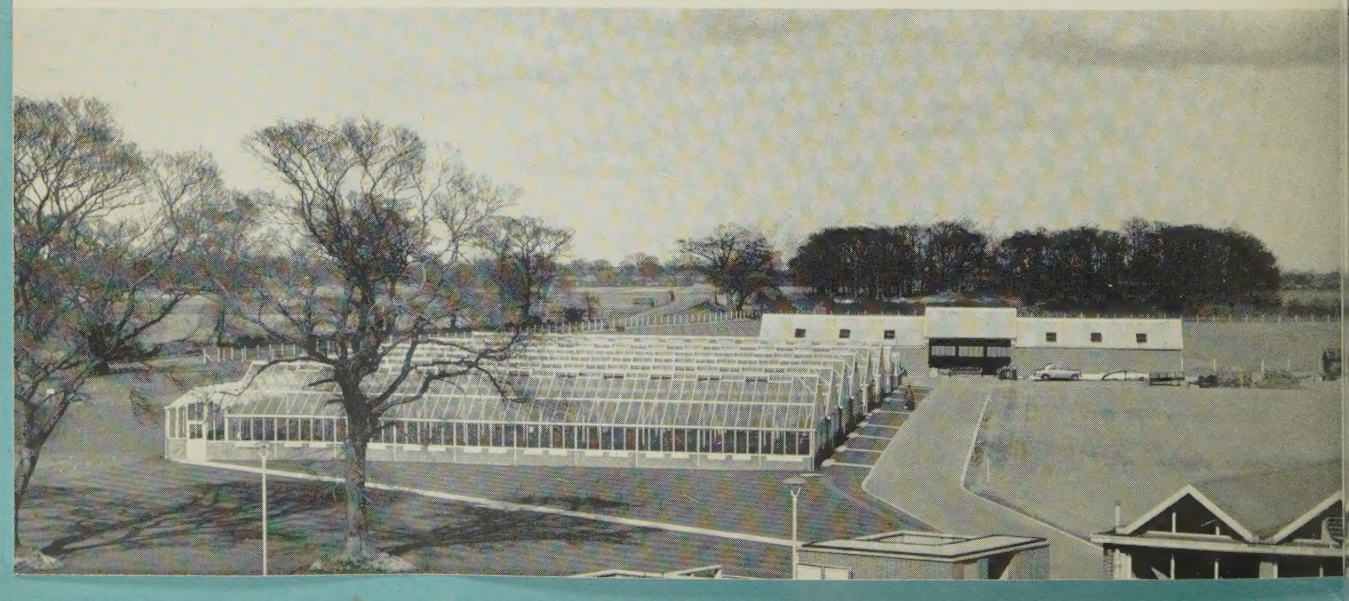
COMMONWEALTH MYCOLOGICAL INSTITUTE
15 DEC 1959

Levington Research Station buildings consist of a laboratory and administration block, process laboratory, pot trials unit, canteen, garages and stores. Three hundred acres of farm land and a sixty-acre horticultural unit with glasshouses are attached.

Top: The Levington organization includes North Wyke Experimental Station near North Tawton in Devon for grassland research.

Left: Bramford Development Station provides facilities for chemical engineering studies.

Below: The Horticultural Unit of sixty acres is almost exclusively devoted to research on crops grown to commercial standards and to fine turf investigations.



LEVINGTON
RESEARCH STATION
1958

Director:
J. A. Storrow, M.Sc.Tech., Ph.D., D.Sc.(Manch.), M.I.Chem.E.

Deputy Director:
J. G. Hunter, B.Sc., Ph.D.(Glasgow), F.R.I.C.

Levington,
Ipswich,
Suffolk

FISONS LIMITED

DEPARTMENT OF CHEMISTRY

Head of Department — J. R. Arthur, M.A., B.Sc.(Oxon.), Ph.D.(Lond.), F.R.I.C.

Co-ordination

Chief Chemist — T. P. Dee, B.Sc.(Lond.), F.R.I.C., M.I.Chem.E.

Basic Research Group

Chief Chemist — * * * *

Fundamental Research Section 1

Senior Chemist — A. L. Whynes, B.Sc., Ph.D.(Lond.), A.R.I.C.

Chemists — F. W. Bennett, B.A., Ph.D.(Cantab.)
R. J. Cave, B.A.(Oxon.)
K. F. J. Thatcher, B.Sc., Ph.D.(Lond.)
* * * *

Fundamental Research Section 2

Senior Chemist — K. S. Barclay, B.Sc., Ph.D.(B'ham)

Chemists — T. R. Bates, B.A.(Oxon.)
J. M. Crewe, B.A.(Oxon.)
R. F. Enefer, B.Sc.(Nott.)

Physicist — R. V. Coates, B.Sc., Ph.D.(Brist.)

Analytical Section

Senior Chemist — W. C. Hanson, A.R.I.C.

Chemists — I. Johnston, A.R.I.C.
J. McMillan, B.Sc.(B'ham)
* * * *

Process Research Group

Chief Chemist — T. P. Dee, B.Sc.(Lond.), F.R.I.C., M.I.Chem.E.

Manufacturing Laboratory Section

Chemists — J. K. Bradley, B.Sc.(Lond.), A.R.I.C.
G. G. Brown, B.Sc.(Lond.)
H. F. Godson, B.Sc.(Edin.)
R. E. Jewell, B.Sc.(Lond.), A.R.I.C.
R. J. Nunn, B.Sc.(Lond.), A.R.I.C.

Chemical Engineering Section

Senior Chemical Engineer — W. F. Sheldrick, B.Sc., M.Sc.(Dunelm), A.M.I.Chem.E.

Chemical Engineer — S. M. Janikowski, B.Sc.(Eng.) (Lond.)

Chemists — D. H. Booth, B.Sc.(Hull)
N. Robinson, B.Sc.(Lond.)
R. G. Wilson, B.Sc.(Lond.)
* * * *

DEPARTMENT OF SOIL SCIENCE

Head of Department	J. G. HUNTER, B.Sc., PH.D.(GLASGOW), F.R.I.C.
Agriculture Section	
Chief Agriculturist	J. A. BIRCH, B.Sc.(LEEDS), N.D.D.
Senior Agriculturist	J. D. WHITEAR, M.A.(CANTAB.), B.Sc., DIP.AGR. (READING)
Senior Field Officer	A. M. AINSLEY, N.D.A.
Agricultural Economist	F. J. ORTON, B.Sc.(LEEDS), B.LITT.(OXON.)
Agricultural Advisers	J. M. COULL, B.Sc.(NOTT.)
	F. W. DUNNETT, N.D.A., N.D.D.
	J. D. EDWARD, C.D.A.
	I. R. ENGLISH, M.C., M.A.(CANTAB.)
	H. P. HENDERSON, B.Sc.(AGR.) (EDIN.)
	W. K. LETHEREN, N.D.A.
	W. A. G. MASON, B.Sc.(READING)
	K. C. MORRISON, M.A.(CANTAB.)
	P. G. SHAW, B.Sc.(READING)
Farm Manager (Levington)	J. T. PEMBERTON, B.A.(CANTAB.)
Farm Manager (North Wyke)	R. H. PELLY, B.A.(CANTAB.)
Grassland Research Section	
Chief Grassland Research Officer	F. E. MOON, M.Sc., PH.D.(DUNELM), N.D.D., F.R.I.C.
Grassland Research Officer	* * * *
Grassland Experimental Officer	P. E. J. Gwynn, N.D.D.
Horticulture Section	
Chief Horticulturist	O. B. ORCHARD
Horticultural Research Officer	D. T. MASON, B.Sc., PH.D.(READING)
Horticultural Advisers	P. S. ATKINS, B.Sc.(NOTT.)
	J. C. BUSH, B.Sc.(READING)
	R. F. CLEMENTS, N.D.H.
	G. A. V. ELLIS, N.D.H.
	C. P. QUARRELL, B.Sc.(READING), N.D.H.
Turf Adviser	D. J. ALLOTT, B.Sc.(LOND.)
Field Experiment Section	
Chief Field Experimental Officer	J. R. DEVINE, B.Sc.(AGR.) (GLASGOW), N.D.A.
Senior Field Experimental Officers	M. R. J. HOLMES, M.A., DIP.AGR.(CANTAB.)
	P. G. SHAW, B.Sc.(READING)
Field Experimental Officers	D. W. T. BROUGH, B.A.(CANTAB.)
	H. R. DALLY, N.D.H.
	MISS K. M. WOLTON, M.Sc.(AGR.) (LOND.)
	D. J. TOMLINSON, B.Sc., (AGR.) (DUNELM)
	* * * *

Statistics Section

Senior Statistician	J. C. DICKINS, M.A., DIP.STAT.(CANTAB.)
Mathematician	* * * *

Analytical Section

Senior Soil Analyst	J. HISLOP
Senior Soil Analyst	E. E. JUSA, D.PHIL.(VIENNA)

Soil Chemistry Section

Chief Soil Chemist	S. LARSEN, M.SC.(AGR.) (COPENHAGEN)
Soil Chemists	I. J. COOKE, B.SC., PH.D.(LEEDS), A.R.I.C.
	D. GUNARY, B.SC.(NOTT.)
	D. J. PARTON, B.SC.(WALES)
	* * * *(2)

Biochemistry Section

Senior Biochemist	F. E. G. HARRAP, B.SC., PH.D.(LOND.), D.I.C., A.R.C.S.

Plant Physiology Section

Senior Plant Physiologist	P. C. OWEN, B.SC.(WALES), PH.D.(LOND.)

Biology Section

Senior Biologist	R. C. STEPHEN, B.SC., PH.D.(ABERDEEN)
Biologist	J. S. WAID, B.SC.(LOND.), B.SC.(OXON.)

BRAMFORD DEVELOPMENT STATION

Manager	F. R. SCHOFIELD, B.SC.(ENG.) (LOND.), A.M.I.CHEM.E.

Chemical and Technical Services Section

Chemists and Chemical Engineers	C. N. SILVESTER, B.SC.(SHEFF.), A.M.I.CHEM.E.
	R. M. BOLT, B.SC.(DUNELM.)
	J. M. CLARKE, B.SC.(B'HAM.)
	J. E. A. FISON, B.SC.(ENG.) (LOND.), A.M.I.CHEM.E.
	W. G. MASSON, B.SC.(B'HAM.)

Fertilizer Section

Chemists and Chemical Engineers	W. J. W. NUNN, B.SC.(ENG.) (LOND.)
	R. M. DANNATT, B.SC.(WALES), B.A.(CANTAB.)
	R. W. PALMER
	W. A. WHITE

Laboratory Section

Chemists	J. W. FOX, B.SC.(LOND.), A.R.I.C.
	D. B. RATCLIFFE, A.R.I.C.

ADMINISTRATION

Accountant-Secretary	C. HANCOCK, A.C.W.A.
Assistant Accountant	W. H. FOX, A.C.C.A.
Librarian	MISS E. M. WATSON, M.A.(DUNELM.)
Administrative Officer	D. W. DUKE-WILLIAMS, M.A.(CANTAB.)
Maintenance Superintendent	H. G. HORNE

Seconded for 1958 to Production Department as Project Manager:
K. A. SHERWIN, B.SC.(ENG.) (LOND.), D.I.C., A.M.I.MECH.E., M.I.CHEM.E.

Appointments to be made in the development of the Station are indicated * * * *.

LEVINGTON RESEARCH STATION was established by Fisons Limited to provide research of the highest standards into the use of their existing products and the development of new and improved fertilizers. The recommendations for the use of Fisons fertilizers depend upon the testing of products on the farms at Levington and North Wyke and in the many trials carried out all over Great Britain.

The research of the Fertilizer Division is centred on Levington which comprises the central laboratories with the associated farms and horticultural area. Supporting the Levington Research Station are the ancillary establishments of North Wyke Experimental Station in Devon for grassland research, and of Bramford Development Station near Ipswich for testing new processes on the pilot-plant scale. The administrative staff at Levington provide the services at these sites including the accounting, library, instrument and engineering-workshop facilities which are necessary in a scientific research group requiring associated endeavours ranging from economic appraisals to the design of equipment. The scientific work of the Levington Station is divided between the Department of Soil Science and the Department of Chemistry. The former deals with soil and agronomic problems, seeking the greatest benefit from the combination of natural factors and the use of fertilizers. The fundamental studies and experimental investigations of materials in the Levington laboratories, pot trials and field experiments are supplemented by extensive trials throughout the country, controlled by the central staff and conducted by the officers of the Agriculture and Horticulture Sections on land of co-operating farmers and growers. The Department of Chemistry investigates new and improved processes for producing plant nutrients in forms which have suitable properties in manufacture, handling and use. Process developments are transferred for appraisal on the larger scale at the Bramford Development Station, where suitable control laboratories, workshops and more extensive Chemical Engineering facilities are available. This Station also studies plant operation and modification problems in collaboration with the manufacturing works of the Fertilizer Division.

The research stations are all of recent establishment and it is expected that the research groups will be expanded over the next few years, particularly at graduate level. The present complement includes about ninety graduates and two hundred and fifty non-graduate staff and wage-earners.

Department of Chemistry

Two main types of problem are studied in the Department:

(a) Complete and partial manufacturing processes on the bench and semi-technical scale.

(b) Supporting work on the properties of individual and mixtures of fertilizers which influence manufacturing procedures, handling and storage properties.

The Department is composed of two main Groups whose activities are largely defined by the division of the work according to the main two problems stated above. These Groups are the Basic Research Group and the Process Research Group.

Basic Research Group

This is divided into three Sections dealing with physico-chemical research and analytical problems.

Fundamental Research Section 1. Studies are in progress of the kinetics of absorption of gases, the drying characteristics of granular materials, and equilibrium properties of fertilizer/moisture systems.

Fundamental Research Section 2. Present studies include kinetic studies of some thermal reactions in mixed fertilizers, the diffraction of X-rays by inorganic salts, structural and availability studies of retarded nitrogen release fertilizers, and the thermal analysis of fertilizers.

Analytical Section. This Section is responsible for all chemical analytical work coming from the Departments of Soil Science and Chemistry dealing with fertilizers and with fertilizers with pesticides incorporated. The specific determination of pesticide concentration in the presence of fertilizer environment creates numerous analytical difficulties, but considerable progress has been made. A balance is maintained between routine analysis and development of new analytical methods.

Process Research Group

The process research group is divided into two sections, one of which is mainly concerned with laboratory scale research and the other with semi-technical scale work in the Process Laboratory.

Manufacturing Laboratory Section. Herein investigations are carried out aiming at the continued improvement of the range of fertilizers marketed. The work is done in close collaboration with the Production Department, the Soil Science Department and the Fundamental Research Group. Studies of portions of overall manufacturing processes are made with the particular objective of predicting large-scale behaviour. The assessment of storage characteristics forms an important part of the work and an excellent laboratory test method has been developed for this purpose. A number of special fertilizers are prepared for field experiments and pot trials by the Soil Science Department.

Chemical Engineering Section. This is composed of a team of chemical engineers and chemists, the main duties are concerned with design and operation of semi-technical plant to investigate new and improved manufacturing processes: the Section has recently become self-supporting for its analytical control work.

Bramford Development Station

The investigations at this Station are comparable with those in other chemical engineering development laboratories. The work is concerned with examining the efficiency of the current production processes in the works of the Division and with the developments stemming from the new processes and techniques studied in the Levington Chemistry Department. The Station has its own workshop and scientific abilities for designing and erecting pilot plant with associated control instruments. Its major studies thus range from the re-appraisal of hitherto established processes for the manufacture and handling of nitrogenous and phosphatic nutrient source materials to the investigation of novel procedures of chemical processes, physical operations and automatic control.

The graduate staff of chemists and chemical engineers is subdivided into groups having major interests within the field of subjects mentioned above.

Chemicals and Technical Service Section. The Section is concerned mainly with fertilizer component production and raw material assessment, for example studies on the reactivity of rocks, and operating conditions for phosphoric acid production. Packaging and handling investigations provide a major field of study, which includes the design and large-scale testing of efficient bag construction for products.

Fertilizer Section. Process investigations are made on the manufacture of compound fertilizers incorporating nitrogen, phosphate and potash from various sources. These may require tests on small-scale plant or controlled tests on full-scale equipment on the Division's manufacturing sites. The investigations also cover the works' problems of large-scale storage, effluent treatment and plant control, where experimental development work may be required.

Laboratory Section. The laboratories provide the analytical control service for the above experimental programmes, together with similar services on raw materials and products for other Departments of the Division.

Department of Soil Science

The Soil Science research programme is designed to advance knowledge of soil and agronomic problems especially in relation to fertilizer usage. The long-term study of fundamental principles is of primary interest, but many problems of more immediate concern are also considered. Laboratory studies, pot and field investigations are closely integrated.

Agriculture Section. At Levington the two farms occupy over three hundred acres. Most of this area is suitable for arable crop experimentation and the farming policy is designed to produce conditions favourable for this. On the remainder there is mixed farming in which winter beef production and a Red Poll dairy herd take their place. About seventy acres are used for demonstrating the effects of various rates of fertilizer treatment and estimating their profitability

in both arable and mixed farming rotations. Grassland farming is the main study at North Wyke Experimental Station in Devon, which differs greatly from Levington in being a heavy-soil farm in a high rainfall area. An Ayrshire dairy herd is the basis of production but beef animals and sheep have been introduced. At both centres, the needs of research govern long-term cropping and livestock programmes and land utilization. An Agricultural Economist advises on various enterprises.

Ten officers comprise the provincial field and advisory services of the Levington organization. As the experimental results obtained at Levington and North Wyke require to be examined under the greatly differing soil and climatic conditions found in different parts of the country, each officer supervises annually in his area about eight hundred plots mainly in statistically designed experiments. The officers are also available to supply specialist advice to farmers.

Grassland Research Section. Improved production and utilization of grass is regarded by many as the main problem of the agricultural industry. This led the company to set up at North Wyke in Devon, a Station specifically charged with research on the production and utilization of grass especially in relation to fertilizer usage. In addition to replicated plot experiments in which grass production is measured by harvesting and weighing, experiments utilizing grazing animals are being started. Fertilizer responses in grass under pasture management will be measured and pasture quality differences examined in terms of milk production or liveweight gain. An examination is being made of experimental techniques for use under grazing conditions and of 'simulated grazing' techniques which might enable the experimental work to be extended. The requirements of the grassland research programme will largely determine the farm policy at North Wyke. The section is also responsible for co-ordinating the grassland experimental programme at Levington and in the provinces.

Horticulture Section. At Levington, nine glasshouses constructed and operated according to normal commercial practice and covering half an acre are planted with tomatoes, cucumbers and carnations. Heating of the houses is by a high-speed hot water system using $1\frac{1}{4}$ inch pipes. House temperatures are thermostatically controlled. The first season's programme of research projects has been satisfactorily completed. Tomatoes cropped at the rate of 80 tons per acre and cucumbers at 185 tons. These yields are above the average for the glasshouse

industry, and as the majority of the treatments already laid down will be continued for some years, they are of considerable importance for comparing treatment effects on crop yields in following years. The marketing of carnations began at the end of July, and by the end of the year a satisfactory yield of 9·4 blooms per plant was obtained.

Twenty-eight acres of apples and pears are grown on the delayed open-centre method, and five acres of blackcurrants and two of strawberries have been established. About five acres of vegetables are grown annually.

These crops are produced entirely for research purposes in which the Section collaborates with the Field Experimental staff, thus ensuring that experimentally valid results are related to crops produced to commercial standards. Most of the top-fruit area will not be under experiment until the trees are fully established. Fine turf investigations are proceeding on a wide variety of subjects.

The Section has a staff of eight, comprising a horticultural research officer, a turf specialist, and horticultural advisers who are stationed at Levington or in the provinces.

Field Experiment Section. The agricultural and horticultural experiments at Levington and North Wyke are the responsibility of the Section which also collaborates with the Agriculture Section in managing those sited in East Anglia and the South West. Details of all provincial experiments are organized by the Levington staff, who also investigate field techniques and machines designed to improve the reliability of experimental results. Pot experiments are carried out in the glasshouses and covered cage of the Pot Trials Unit and a service is also provided in this way to other Sections of the Department.

Statistics Section. Field and pot trials are designed and a computing service for the statistical reduction and analysis of data is provided. Experimental techniques are investigated statistically and advice is given on problems of a more general mathematical nature.

Analytical Section. Soil and crop samples are taken through routine analysis at a rate of 60,000 samples annually. Of these samples 31,000 form part of the advisory service to farmers and growers, the remainder being derived from research investigations. Considerable attention is being devoted to the application of mechanization and automation techniques to facilitate these analyses.

Soil Chemistry Section. The fundamental features of the soil-plant phosphorus relationship are little understood and in view of the importance of the subject, the Soil Chemistry Section has selected it as the main problem for investigation. Studies on labile soil phosphorus (the L-value) are an integral part of the Section's approach to the problem. In the course of this work the average L-value of twenty-three British soils was found to be 2·4 mg mols PO_4 per kg soil with a variation from 1·1 to 4·5. To the same soils 500 and 1,000 lb P_2O_5 per acre were applied in the field as superphosphate. The two quantities were approximately equivalent to 3·5 and 7 mg mols PO_4 per kg soil respectively. The average L-value immediately after enrichment with P_2O_5, was found to be 6·6 and 9·9 indicating that complete recovery of P_2O_5 was obtained. It is intended to follow the movement of the L-value in these soils over a number of years to determine whether the phosphate applied in 1957 remains labile, and if not, to assess the soil factors which influence the immobilization of applied labile phosphorus.

As heavy dressing with phosphate was and will be employed in plant culture experiments, the adverse effect of very large applications of phosphate which occurs occasionally was studied. There was reason to assume that phosphate influenced the manganese-iron relationship of the plants and this was examined in a pot experiment with tomatoes as the test crop. The phosphate level was found to have no effect on the soluble-iron/soluble-manganese ratio in the sap and this ratio was not correlated with the toxicity symptoms induced by the very large phosphate applications.

The Section also studies other nutrients, for example nitrogenous fertilizer, and their chemical reaction in soil.

Pot trial studies including technique are also important. Sub-irrigation of pots by standing them in wet sand was found to provide adequate water for normal growth. The technique is useful for many types of experiment but minor modifications are required. In experiments using a modified Jenny technique to examine the nitrogen, phosphate and potash status of soils, lettuce was adequate in detecting the relative large nutrient responses which occurred though the variability was high. On the whole, lettuce is an unsatisfactory indicator crop for experiments unless there is extensive replication. In other experiments, soil conditioner was found to have no effect on crop response

to phosphate, while partial sterilization by steaming decreased phosphate responsiveness, the effect being greatest on soils already highly responsive.

Biochemistry Section. Work continues on an investigation into the nature of the phosphorus compounds in the pea seedling. The construction of an Automatic Chromatogram Scanner for the detection and determination of P^{32} will augment the analytical techniques already in use.

In 1957, work with peas showed that it was possible to reach high levels of activity in pea seeds employing an infiltration method with P^{32}. The seeds germinated and the plants produced pods and seed. This work is related to a study of the phosphorus requirements of plants.

Plant Physiology Section. This recently established section is being developed for investigations associated with the other basic research studies.

Biology Section. The Section is mainly concerned with problems associated with plant/soil micro-organisms relationships, organic matter decomposition studies, and the relation between host nutrition and disease incidence.

Preliminary results obtained under field conditions indicated a reduction in the amount of potato blight disease on the foliage associated with increasing levels of applied nitrogen and potash. These provisional results require confirmation and are being further examined.

The Levington Farms

The two research farms at Levington occupy three hundred and thirty acres which would formerly have been described as typical 'sheep and barley' land. This is descriptive of the type of glacial soil on the plateau between the Deben and Orwell estuaries and is predominantly light loam overlying sand and gravel. Left to natural vegetation it returns to gorse and silver birch scrub locally known as heath. A part of one farm is a valley leading to the Orwell estuary and in it the soils vary considerably and are less suited to field experimentation.

The annual rainfall must rank as one of the lowest in the country, the average for 1957 and the mean for the last three years being respectively 24·64 and 21·66 inches with spring droughts much in evidence. Barley continues to be the most suitable cereal crop but with timely cultivations and sowing, cash and fodder root crops can be made to give high yields in most years.

Early Development and Farm Building

Fisons Limited purchased Walk Farm and Red House Farm in October, 1953. During the farming years of 1954 and 1955, many changes were carried out; banks between fields, which were rabbit infested, were bulldozed out, superfluous fences were removed and scrub eliminated. In addition, hedgerows and five shelter belts were planted, and at Red House Farm all fields were refenced. Some eight hundred tons of clinker were brought on to the farm to make hard standings for the farm buildings and farm roads. At Walk Farm, where the only buildings were two open cattle yards and a tithe barn, three new buildings were erected to give tractor, implement and workshop accommodation, a fertilizer store, grain drying and storage facilities and covered cattle yards for winter beef production. In 1956 a further building was completed at Red House Farm, comprising a milking parlour and dairy, two covered yards with feeding passage, implement shed and dutch barn storage all under one roof. Early in 1957 a range of old buildings at this farm was reconstructed to make loose boxes, calf pens, a meal barn and an open yard. Two pit silos, roofed at Red House Farm and prefabricated and unroofed at Walk Farm, complete the buildings.

Farm Planning

During 1954 and 1955, uniform cropping at low fertilizer rates was carried out to find existing fertility levels in order to select the most uniform areas for future experiments.

Areas which are being prepared for special types of field experiments in which nutrient response is essential, do not receive phosphate or potash until a deficiency occurs; until then only nitrogen is used.

The land which is unsuitable for field experiments is used for commercial crop production.

Since 1956, when results of these first two years had been evaluated, cropping at Walk Farm assumed a more definite pattern, and certain areas were marked out for future use as demonstrational areas, sites for annual experiments to be laid down on a rotational basis, or as sites for long-term experiments. Red House Farm was split to give 60 acres devoted to research on fruit and vegetables, this being an enterprise run as a separate unit by the Horticulture Section. The remaining one hundred acres, ranging in soil type from blow-away sand to stiffish clay/loam, are farmed on a seven-course rotation; long leys with a break

for a kale crop and a minimum of permanent pasture, form a dairying unit supporting a milking herd of thirty Red Polls and followers.

Agricultural Demonstrations at Walk Farm

The object of the two agricultural demonstrations is to record the optimum crop response to compound fertilizer under Levington conditions and to examine costs in relation to yield, residual values receiving consideration. It will be some years before the records from these recently established, unreplicated trials can give a reasonably reliable picture of the position. The demonstrations occupy seventy acres which allow approximately four acres for each crop break in one rotation and three in the other. Each of the three fertilizer treatments for each crop occupies about one acre while the cross-treatment fertilizer residual areas, from the previous cropping year, are about one-third of an acre.

The percentage composition of the compound fertilizers used in these rotations is as follows:-

	N	P_2O_5	K_2O
Fisons 31	9	9	15
Fisons 32	12	9	9
Fisons 35	5	12½	12½
Fisons 37	—	16	16
Fisons 39	9	6	18
Fisons 41	10	10	18

Six-course Cash Crop Rotational Demonstration. This was started in 1956 on area 14, the rotation being: Potatoes, Peas, Wheat, Sugarbeet, Oats, Barley. In all cases three different levels of fertilizer have been applied for each crop. In the case of peas and cereals, these levels increase from north-west to south-east and in the root crops from south-west to north-east; the applications on the root breaks therefore cross the applications on the straw break.

Levels of fertilizer application were:

Potatoes	8, 14, 20 cwt/acre 31 plus Aldrin
Peas	1½, 3, 4½ cwt/acre 37
Wheat	1½, 3, 4½ cwt/acre 39
Sugarbeet	8, 11, 14 cwt/acre 32
Oats	1½, 3, 4½ cwt/acre 39
Barley	1½, 3, 4½ cwt/acre 39

In 1958, 31 plus Aldrin for potatoes has been replaced by 41 plus Aldrin at the same rates. 39 replaced 32 for sugarbeet as visual symptoms of potash deficiency occurred each year. 35 plus Aldrin was used for winter wheat as a protection against wheat bulb fly.

Six-course Mixed Farming Rotation. In this rotation on area 15, grass and lucerne leys are compared. The demonstration is based on three years cocksfoot/white-clover ley and three years pure lucerne, followed in each case by three cereal crops. The first break was undersown in 1956 and became established in 1957. The second and third breaks were undersown to barley in 1957 and 1958 respectively. The three following breaks will be established in successive years.

Fertilizer is applied to these two fodder crops at three levels, a phosphate/potash compound with nitrogen top dressing being used for the grass ley; nitrogen is omitted from the lucerne ley. The cereal crops which follow are to receive three levels of fertilizer treatment at right angles, to detect residual effects from the grass and lucerne.

Rates of fertilizer application are:

Cereals	1½, 3, 4½ cwt/acre 39
Cocksfoot/ clover ley	0, 3, 6 cwt/acre sulphate of ammonia and 3 cwt/acre 37 applied to the whole of each break each autumn.
Lucerne	2, 4, 8 cwt/acre 37

Manurial Reference Trials. These small-scale plots put down in duplicate form in area 14 are related to the rotation demonstrations. The trials were started in 1956 to demonstrate crop growth differences between balanced and unbalanced fertilizer treatments.

All crops receive the following treatments, the rate of application used being appropriate to each crop:

1. No fertilizer
2. Nitrogen only
3. Phosphate only
4. Potash only
5. Nitrogen and phosphate
6. Nitrogen and potash
7. Phosphate and potash
8. Nitrogen, phosphate and potash
9. Nitrogen, phosphate, potash and farmyard manure
10. Farmyard manure only

Field Experiments

A block of over fifty acres at the north of the farm area 11 is designated for future fertilizer experiments of the type in which definite nutrient responses are essential, and a six-course rotation has been designed with this in view. Cropping for 1958 is as follows:

Crop	Fertilizer	Remarks
A. Barley	Nitrogen only	Experimental area 1957
B. Experimental area 1958	Experimental fertilizers	Mustard when not required for experiments
C_1 & C_2 Potatoes	Nil	Experimental area 1959
D. Potatoes	Nitrogen only	Experimental area 1960
E. Winter Wheat	Nitrogen only	Experimental area 1961
F. Red Clover	Nil	Experimental area 1962

In the year preceding the experiments, the crop gets no fertilizer; in other years only nitrogen is applied until either phosphate or potash deficiency appears. Thereafter, small applications of the deficient nutrient will be given to ensure continued withdrawal of the residue of the other. This rotation may be changed if evidence produced by long-term experiments in area 12 indicates that this is advantageous for future experimentation.

The southern part of area 13 is also devoted to annual experiments but in this case there is a normal farming rotation. Long-term and rotational experiments are sited on the extreme south-east side of the farm area 12; the whole of that area and some 12 acres at the northern end of field 15 is in reserve for similar purposes. This leaves less than 50 acres to be farmed commercially.

Stock

Dairy Herd and Cropping at Red House Farm. The dairy herd at Red House Farm is based on about 100 acres, and with the exception of one field (area 1N) optimum fertilizer levels are used. Twenty acres are in permanent pasture and eighteen are in lucerne owing to thin topsoils. The remaining sixty are divided into seven approximately equal fields which are cropped for six years with a long-term ley undersown in barley and for one year with kale. The mixture used for long-term leys has been the cocksfoot/clover type, but partly as a result of experiments conducted at Levington and partly on the grounds of palatability, it is intended to replace cocksfoot by meadow fescue.

In the event of leys wearing out before six years, they will be ploughed up for a short-term Italian rye grass ley. These leys are mainly used for grazing and hay making, but may be taken for silage according to prevailing conditions. For the past two years the practice has been to make two to three silage cuts from the lucerne and to follow this with late grazing. In 1957 two silage cuts were made and a third cut (on contract) yielded nearly a ton of lucerne meal to the acre. The final stand was strip grazed in September.

There are thirty Red Poll cows in the herd. Of these, ten were purchased in the spring 1956 as pedigree in-calf heifers and the remainder, some of them grading-up cows, were purchased either privately or at dispersal sales. The aim is to produce milk as cheaply as possible from grass during an extended grazing season, and in winter to feed hay, lucerne silage and kale, using a balanced concentrate mixture (which is home grown, with the exception of some bought high-concentrate protein) to supplement these foods. During 1957 the herd started to strip graze the Italian rye grass ley on February 9th and finished on November 20th. From April to September inclusive, only a little supplementary feed was given; this amounted to £2 per cow in value compared with the national average of £14 per cow.

In their first lactation, the heifers averaged 8,600 lbs and the average yields of the older cows were slightly lower. The figures are no guide to the future as some cows were bought during lactation.

All calves of both sexes have been reared, but as the numbers grow it is proposed to sell the steers, probably as calves or as young stores, according to the amount of grass available for carrying them. It is probable that in the future we shall rear heifers only, and so make way for increasing the dairy herd which appears to be a more profitable enterprise than rearing on so small a unit.

Winter Beef Production at Walk Farm

To provide farmyard manure for the farm, experimental requirements and horticulture it has been our policy to fatten store cattle in yards. During 1953/4 and 1954/5 this was done in open yards; from 1955 onwards the cattle have been housed in the new covered yards where straw is used liberally and from which some 500 tons of farmyard manure is produced annually.

For the past three years, Friesian steers have been bought at about two years of age and two lots of 80–100 each have been fattened during the winter. It is considered to be more profitable to finish two lots quickly than to carry one lot right through the winter. In any case it is necessary to muck out the yards half-way through the season. To make a profit from such animals when they have to be bought-in as stores at prevailing prices is not easy, but aided by a modern building and by feeding large quantities of bulk foods rather than concentrates, the margin has been narrowed advantageously. During 1956/7, a small profit was made in addition to the value of the muck left behind. The feeder's margin at the very most is estimated to be £20 and as it costs from 20/- to 30/- per week a head to keep the animals in yards, it can be seen that the margin available for profit is a small one.

During the season 1956/7, monthly weighings of all fattening cattle were carried out in order to estimate live weight gains of the fattening bullocks and the data thus obtained proved to be of assistance to the School of Agriculture, Cambridge, who are carrying out research on the rearing of beef steers, with particular reference to the Friesian breed. In 1957/8, the same monthly weighings were carried out and during the fattening of the first batch, half the animals were implanted with Hexoestrol, and liveweight gains between treated and non-treated animals were compared. This trial was carried out in conjunction with the School of Agriculture, Cambridge, and the Fatstock Marketing Corporation. As this trial showed considerable financial benefit from implanting with Hexoestrol, the second batch of cattle, in yards from late January to April, were also implanted as a commercial proposition.

Results of Agronomic Experiments - 1956

Experiments in 1956 covered a wide field of subjects in Agriculture, Horticulture and Pot Trials. In the main, results are restricted to one year's experiments and accordingly the following general statements have limited value.

Some comments on the weather during 1956 may be of value especially in relation to agricultural projects which were investigated on the Stations and throughout the country. The rainfall at Levington from February to May was

2·7 inches, from June to September 9·92 inches and from October to January (1957) 4.79 inches. These contrasts are illustrative of Great Britain as a whole, and in some areas they were even more pronounced. A dry, cold sowing season was followed by a sunless summer and terminated in a wet corn and potato harvest. In some areas the straw was short because of early drought and in others the corn was laid by torrential rain. In isolated instances crops were severely damaged by hail. Many potatoes were under water. On blackland, potato yields were small because of the early drought, but sugarbeet and kale yielded well and benefited from the later rains and the dry, mild autumn. On heavy land, all crops were difficult to harvest. Grass was scarce in the spring, and early grazings and cuts were below average. As the summer progressed grass became plentiful, as it was throughout the autumn and early winter.

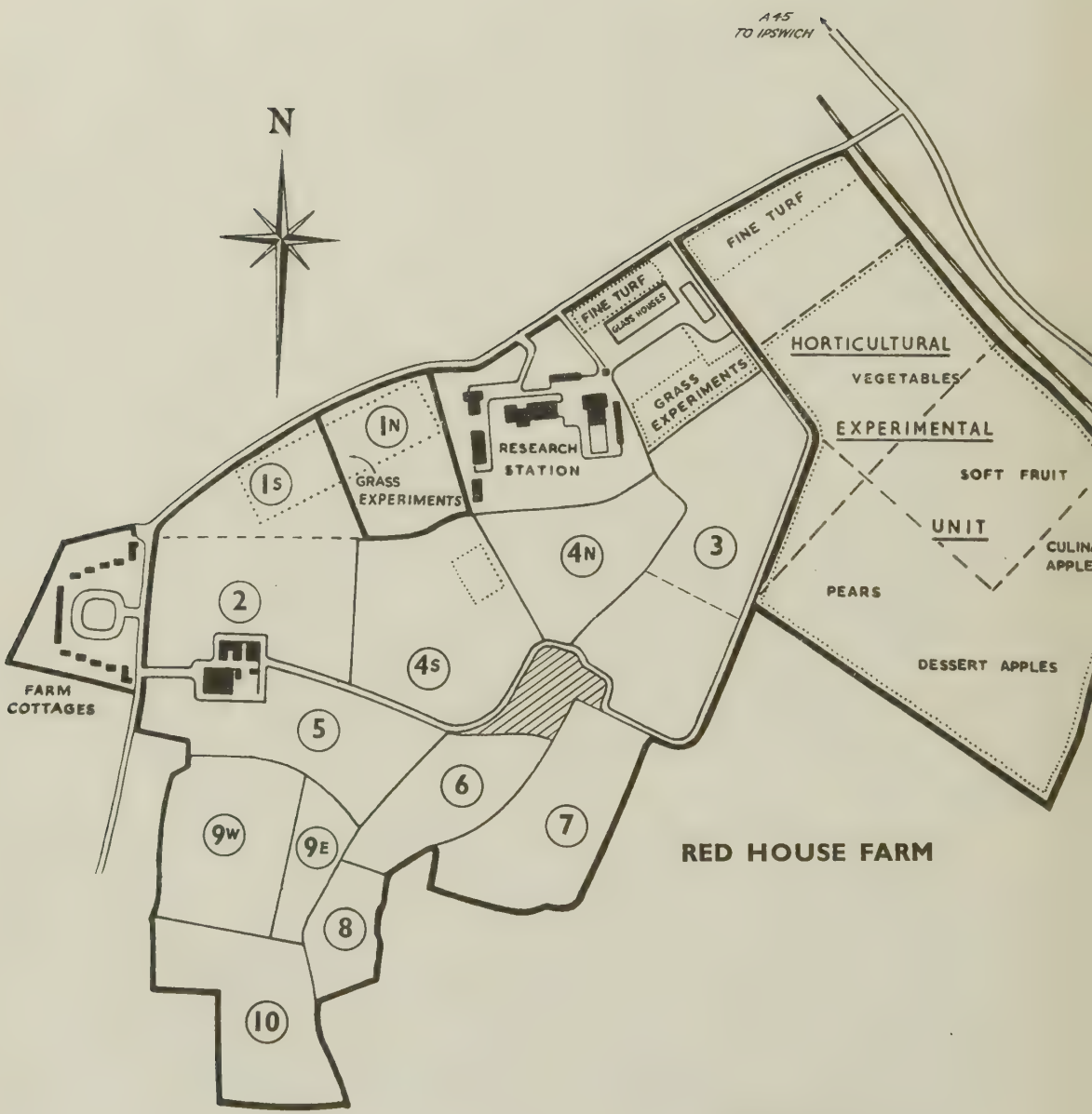
Agricultural Results

In thirteen experiments on cereals, grass and sugarbeet in which ammonium nitrate was compared with ammonium sulphate, ammonium nitrate was never found to be inferior and was sometimes superior to ammonium sulphate. In other experiments the scorching propensity of solid nitrogenous top dressings on grassland was related more to physical form than to chemical constituents, powdered forms producing more scorch than granular. Ammonium nitrate solutions containing free ammonia gave far more scorch on grassland than did ammonium nitrate solutions alone.

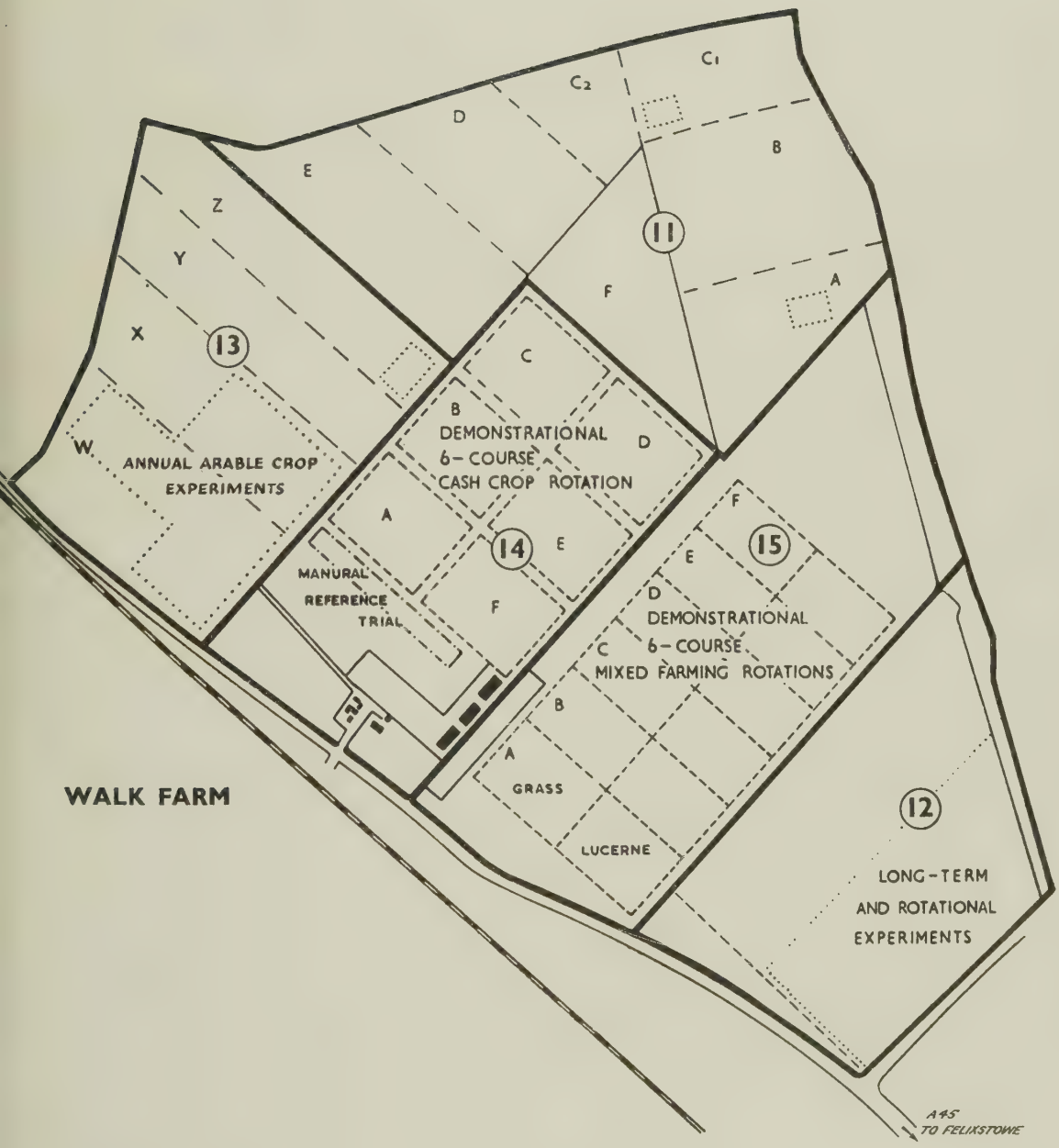
At six centres where the soil pH was over 7, P.E.C. nitrophosphate failed to produce a phosphate response in potatoes but on one acid soil the crop did respond.

Autumn and spring applications of phosphate and potash to grassland were generally equally satisfactory. This confirms results obtained in experiments conducted in the years 1954 and 1955.

Four rates each of nitrogen, phosphate and potash were examined in all combinations for potatoes in ten experiments on typical soil types. Nitrogen increased the yield at six centres, phosphate at five and potash at six. In seven barley experiments nitrogen increased the yield at five, phosphate at three and potash at two. The optimum level of nutrients required at the centres varied considerably and there is no doubt that the peculiar weather conditions at most of the sites was the limiting growth factor.



LEVINGTON RESEARCH STATION 1958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MIXED FARMING ROTATIONS
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EXPERIMENTS
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TO FELIXSTOWE

WALK FARM

Experiments at Levington examining the effect of magnesium applications in combination with other nutrients on pure grass swards with particular reference to magnesium content of the herbage, confirmed many previous results on this subject and showed that it is possible to raise the percentage herbage magnesium by application of magnesium. High levels of nitrogen had a greater percentage magnesium effect which was particularly marked when the nitrogen source was ammonium nitrate rather than ammonium sulphate. In the provinces, over a wide range of sward types similar effects appeared, although in these cases ammonium sulphate was the only nitrogen source. This nitrogen effect on magnesium may be offset by other factors when considered in relation to hypomagnesaemia. An investigation of the cumulative effect of repetitive applications of magnesium combined with compound and nitrogenous fertilizers on the incidence of hypomagnesaemia in a dairy herd is still in its early stages.

At eleven potato sites testing magnesium applications at low and high levels of applied potash, there was no indication of a widespread general need for magnesium on typical light potato soils even at high potash rates of application. Applications of manganese and copper were not successful in raising the yield of sugarbeet on six typical soils, and at five sites on oats no effect of these treatments appeared.

Response of topine to fertilizer at Levington was small, confirming the results of a previous experiment.

Good control of wireworm damage to potatoes by various insecticides incorporated in compound fertilizer was demonstrated at Levington and elsewhere. Tasting tests, which are a regular procedure in assessing products at Levington, failed to detect any tainting of the tuber by the insecticides even at high rates. Tecane incorporated in fertilizer at 3·75 lb. per acre achieved an 85 per cent kill of wild oats in sugarbeet and increased yield of beet – a greater application rate is normally required.

The experiments in this year's work examining the effect on potatoes of rates of nitrogen, phosphate and potash and of different sources of nitrogen and potash showed that (a) insufficient potash is one of the causes of blackening of the tuber after cooking, (b) a very high rate of potash lowers the dry matter content (and therefore quality) and (c) sulphate of potash produces a potato of higher dry matter than does muriate of potash besides increasing the ratio of seed to ware. The beneficial effects of potash on dry matter were further shown by the texture scores of the tasting panel.

Horticultural Results

A tomato crop in an unheated glasshouse gave equal yields from solid and liquid fertilizers (Fisons G.H.3 and L.3), the quality of the fruit being the same. In the liquid feeding treatments the rates varied from 19 to 27 gallons per acre and the dilutions from 1:250 to 1:1,500, neither variation having an effect on the yield or quality of fruit.

Chelated iron and magnesium were examined on tomatoes and a number of glasshouse flower varieties, with particular reference to improvement of fruit quality and the correction of chlorosis. There was no evidence that these materials improved the plants. The colour and vigour of the foliage of a number of flowers and vegetables grown outdoors under normal soil conditions were not improved. Except at low rates of application, the materials were toxic.

Ureaformaldehyde was used as a replacement for standard organic fertilizers in base and top dressings for tomatoes. In a base dressing which had all its nitrogen in organic form, ureaformaldehyde did not appear to be a satisfactory substitute. In top dressings the substitution of ureaformaldehyde may have been satisfactory but it is possible that the total nitrogen applied was more than adequate for the requirements of the plant so that differences would not be expected; the experiment should be regarded as inconclusive. Measurement of the residual nitrogen was done in pots, using mustard as an indicator crop, and showed greater residual effects from ureaformaldehyde than from conventional organic materials.

Various insecticides incorporated in fertilizer controlled cabbage root fly attack and also gave some control of aphid attack.

Pot Trial Results

The pot trials unit was not completed until the late spring of 1957. Until that time a small number of glasshouse experiments were carried out and some results from them are given here.

Two experiments investigated the scorch damage related to top dressing nitrogenous fertilizers on grassland. Fertilizer in contact with the leaf produced localized necrosis which was most severe from the most alkaline source and which decreased in severity with fertilizers of lower pH.

Long-term experiments measuring the rate of release of nitrogen from standard inorganic and organic sources including ureaformaldehyde show, from

the first season's growth, that the rate of release of nitrogen from ureaformaldehyde is slower than that from other sources; also the rate of release appears to be maintained at a constant level for a longer period than with other organic or inorganic sources.

The sand-bed cultural technique in which pots stand in a bed of wet sand, thus supplying water to the plants by upward absorption, has been examined using various sizes of whale-hide pots and various crops. On the whole it has proved to be a satisfactory method for most crops. Some difficulty was experienced at first in obtaining satisfactory germination of seeds but this was overcome by sowing the seeds on the surface of the soil and covering them with a layer of wet vermiculite one-quarter inch deep.

Field and Pot Experiments - 1958

Field and pot experiments, an essential part of the fundamental and applied studies, link laboratory investigations with farm and horticultural practice. The research farms, the horticultural unit, and the provincial advisory service throughout the United Kingdom are available for carrying out experiments. In this way, research projects organized from Levington can be examined in all phases of the soils and climate which constitute British farming and horticulture. This season more than sixteen thousand plots in agricultural and horticultural experiments are being laid down, over half being provincial, and the Pot Trials Unit at Levington has an extensive supplementary programme.

Agricultural Field Experiments

In the 1958 agricultural programme there are 324 experiments comprising 13,097 plots. Many of the experiments carried out in 1957 are repeated to obtain information under different conditions. Such experiments examine (a) sources of nitrogen for grassland and arable crops, (b) top-dressing phosphate and potash for established lucerne and starter fertilizer for establishing the crop, (c) nitrophosphates, (d) phosphate and potash requirements of crops when high nitrogen levels are supplied, (e) granule size of compound fertilizers, (f) magnesium for arable crop production and for grassland in relation to animal health, (g) fertilizers incorporating insecticides for wireworm control, and herbicides for weed control, (h) field experimental technique. New studies

include (i) the effects on spring grass composition of small annual applications and of repeated small doses of magnesium compounds, (j) improvement of marginal grassland by application of lime, slag and trace elements, (k) wheat bulb fly control by fertilizers incorporating insecticides, (l) plant nutrition in relation to 'take-all' and 'blight' incidence.

At Levington there are fully thirty acres occupied by annual and long-term experiments. Crops under investigation are grass, clover, Russian comfrey, autumn and spring cereals, potatoes, sugarbeet and cabbage.

Key to Locations

L	Levington Research Station, Ipswich, Suffolk
W	North Wyke Experimental Station, North Tawton, Devon
E	East Anglian counties
1	Aberdeen and North-East Scotland
2	Edinburgh and South-East Scotland
3	Carlisle and North of England and South-West Scotland
5	Chester and West Midlands, North Wales and Lancashire
6	York and Yorkshire
7	Lincoln and East Midlands
8	Bristol and surrounding counties
9	South-Western counties
11	Guildford and South-Eastern counties

Code No.	Title	Crop	Subject under investigation	Locations where sited
1.1/1	N source and time	Spring cabbage	A number of nitrogenous fertilizers applied in autumn – cabbage as indicator crop	L
1.1/2	N source, top dressing	Winter wheat	Efficiency of various nitrogenous fertilizers as spring top dressing	5, 8, 9, 11
1.1/3	N source, seedbed	Barley	Efficiency of various nitrogenous fertilizers applied to seedbed	6, 7, 8, 11
1.1/4	N source and time	Grass	Time of application in relation to spring growth	L, 6, 7, 9
1.1/5	N source, seedbed	Sugarbeet	Efficiency of various nitrogenous fertilizers applied to seedbed	E, 6, 7, 8
1.1/6	N source – scorch, yield	Grass	The effect of various nitrogenous fertilizers (as top dressing) on herbage scorch and yield	L, E, 9

Code No.	Title	Crop	Subject under investigation	Locations where sited
1.1/7	N rate and time	Grass	The effect of autumn and spring applications on spring growth	1
1.1/8	N rate and time	Barley	The effect of time of application (late) on yield and quality of grain	L, 9
1.1/9	N source, calcareous soils	Grass	The efficiency of various nitrogenous fertilizers	L, E, 8, 11
1.1/10	N source, calcareous soils	Grass	The efficiency of various nitrogenous fertilizers	E, 6, 7, 8
1.1/11	N source, acid soils	Grass	The efficiency of various nitrogenous fertilizers	1, 3, 5
1.1/12	N source, method of application	Barley	The effect of time and method of application on efficiency of nitrogenous seedbed dressings	E, 7, 11
1.1/13	N source, method of application	Cabbage	The effect of time and method of application on efficiency of nitrogenous seedbed dressings	L, E
1.1/14	N rate and time	Kale	Time for applying nitrogenous fertilizer	3, 5, 8
1.1/15	N rate and time	Barley	The effect of time of application between seedbed and top dressing on grain yield and quality	3, 5, 9
1.1/16	Soil N uptake	Grass	The relationship between soil nitrogen and yield on all grass swards	L, E, 1, 2, 3, 5, 6, 7, 8, 9, 11
1.1/17	N, Mg – late application	Barley	The effect of nitrogen and magnesium applied as solids and as foliar sprays in June	3, 5, 8
1.2/1	Basic slag, acid soils	Grass	The value of various types of basic slag	1, 5
1.2/2	P rate and time	Lucerne	The effect of rate and time of application of phosphate on yield of established lucerne	E
1.2/3	P top dressing	(a) Swedes (b) Oats	Effect on growth of top dressing phosphate at varying times	1, 2, 3 1, 3
1.2/4	P/Manganese interaction	(a) Sugarbeet (b) Oats	The relationship between phosphate response and manganese supply	E, 6, 8 1, 6, 7
1.2/5	P source, nitrophosphates	Various	Residual effects of nitrophosphate experiments conducted in 1957	E, 1, 3, 5, 7, 8, 9, 11
1.2/6	P source, nitrophosphates	Potato	The effect of varying proportions of water-soluble phosphate on crop yield	E, 5, 9, 11
1.2/7	P source and time, calcareous soils	Grass	Various sources of phosphate examined in relation to influence on sward composition and yield	7, 11

Code No.	Title	Crop	Subject under investigation	Locations where sited
1.2/8	P source and time, acid soils	Grass	Various sources of phosphate examined in relation to influence on sward composition and yield	3, 6, 9
1.3/1	K top dressing	Barley	Investigating the usefulness of potash top dressings on yield	8, 11
1.3/3	K rate and time	Lucerne	The effect of rate and time of application of potash on yield of established lucerne	E
1.4/1	NP rate and P time	Grass	Time and rate of phosphate application in relation to nitrogen rate	2, 3, 11
1.5/1	NK rate and K time	Grass	Time and rate of potash application relative to nitrogen rate	5
1.7/1	NPK rate	Potato	Nitrogen, phosphate and potash rates in relation to yield, disease control and soil analyses	E, 1, 2, 3, 5, 6, 7, 8, 9, 11
1.7/2	NPK rate, farmyard manure	Barley	Residual effects of experiment conducted in 1957	L
1.7/3	High N balanced with P and K	(a) Spring wheat (b) Barley	Examining the optimum rates of phosphate and potash in relation to nitrogen	E, 5, 9 3, 6, 8, 11
1.7/4	NPK rate	Grass	Effect of each nutrient alone and in all combinations on yield and sward composition	1, 3, 8
1.7/5	NPK rate	Oats	Residual effects of experiment conducted in 1957	W
1.7/6	NPK rate, farmyard manure	Barley	Residual effects of experiment conducted in 1957	L
1.7/7	NPK rate	Oats	Residual effects and time to regain nutrient response uniformity in crops	W
1.7/8	NPK rate	Swede	Residual effects and time to regain nutrient response uniformity in crops	W
2.2/1	NPK and Mg rate	Grass	The effect and interaction of these nutrients on magnesium content of herbage	L
2.2/2	NPK and Mg rate	Grass Species	The effect of low and high fertilizer application on magnesium content of herbage	L
2.2/3	N, Mg rate and N source	Grass	A variety of nitrogenous fertilizers at various rates and their effect on magnesium content of herbage	L

Code No.	Title	Crop	Subject under investigation	Locations where sited
2.2/4	NPK, Mg rate	Clover	The effect and interaction of these nutrients on the magnesium content	L
2.2/5	Mg rate and time	Grass	The effect of autumn and spring application on magnesium content	L
2.2/6	NK, Mg rate and K time	Grass	The effect of various times of application of potash on the composition of early spring grass	11
2.2/7	K and Mg rate	Potato	The effect on yield on soil where a magnesium response may be expected	2
2.2/9	Mg rate	Rotation of crops	The additive effect of magnesium applications over successive years on crop yields	1
2.5/1	Marginal land development	Grass	The effect of a variety of nutrients on productivity	1, 2, 3, 5, 8, 9
2.5/2	Trace element requirement	Oats	Response to trace nutrients on normal agricultural soils	1, 5
2.5/3	Boron and magnesium application	Lucerne	Observations on the effect of these nutrients on growth and yield	8, 11
2.5/4	Chelated copper	Sugarbeet	Effect of chelated copper on soils producing symptoms of copper deficiency in crops	E
2.5/5	Chelated manganese	Sugarbeet	Effect of chelated manganese on soils producing symptoms of manganese deficiency in crops	E
2.12/1	Granule size, compound fertilizer – P source	Grass	The effect of granule size on crop response to phosphate	5, 6
2.12/2	Granule size – P source	Swede	The effect of granule size of nitrophosphate	1, 2, 3, 9
2.12/3	Granule size, compound fertilizer – P source	Swede	The effect of granule size on crop response to phosphate	5, 6
2.12/4	Fertilizer form and rate	Early Potato	Compound fertilizer formulations and rates; yield	3
2.12/5	Fertilizer form and rate	Early Potato	Compound fertilizer form; sprouting and yield	7
2.13/1	NPK placement	Barley	High rates of compound fertilizer combined drilled; establishment and yield	L, E
2.14/1	NPK exhaustion	Potato	Response to these nutrients after successive years of nitrogenous fertilization in rotations	L

Code No.	Title	Crop	Subject under investigation	Locations where sited
3.2/1	P storage	Rotation	Availability of phosphate in a variety of important soil types following phosphate applications	L, W, E, 1, 3, 5, 6, 7, 8, 9, 11
3.2/2	P storage	Rotation	Availability of phosphate in two soil types following phosphate applications	2
3.7/1	High N balanced with P and K	Rotation	The place of phosphate and potash in obtaining maximum crop yields from nitrogen	L
4.2/1	Cumulative Mg top dressings	Grass	The long-term effect of repetitive small applications of magnesium on magnesium content of herbage	W, 1, 2, 8
4.4/1	Sulphur requirement	Rotation	The sulphur requirement of crops over a long period	L
4.14/1	PK exhaustion	Rotation	Rotations that will best produce phosphate and potash responsiveness	L
4.14/2	K exhaustion	Rotation	Residual effect of potash applied to area designated for annual fertilizer experiments	L
6.6/1	NPK rate and time, establishment	Lucerne	The need for nitrogen and most suitable time for applying phosphate and potash	E
6.6/2	NPK rate, establishment	Grass	Nutrient requirement for grass establishment	W
6.7/1	NPK rate, species	Grass	Nutrient requirement of various grass species	W
6.9/1	NPK rate	Russian Comfrey	Nutrient requirement of an unusual crop	L
7.2/1	Mg, hypomagnesaemia	Rotation	The effects on animal health of magnesium applied to grass and other fodder crops over several years	11
8.7/1	NPK, take-all relationship	Winter wheat	The effect of host nutrition on the incidence of take-all	L
8.7/2	NK rate, blight relationship	Potato	The effect of these nutrients on the crop's susceptibility to blight	W, E, 1, 7
9.3/1	Wheat bulb fly, control	Winter wheat	Aldrin, phosphate and potash on the incidence of attack	E, 1, 6, 7
9.3/2	Wheat bulb fly, control	Winter wheat	Fertilizers and various insecticides and methods of application	E, 6, 7
9.3/3	Aldrin, tuber quality	Potato	The effect of fertilizer containing aldrin on wireworm control and tuber quality	W, 2, 5
9.3/4	Wireworm, control	Sugarbeet	Various methods of applying aldrin combined with fertilizer	E

Code No.	Title	Crop	Subject under investigation	Locations where sited
9.3/5	Wheat bulb fly, control	Winter wheat	Various incorporated insecticides combined drilled	1
9.3/6	Aldrin placement, wireworm control	Potato	A variety of placement positions in relation to the planted seed are examined	L, E
10.2/2	Herbicide, weed control	Grass	The influence of herbicide on yield and composition of sward	W
10.4/1	Herbicide, fertilizer, weed control	Grass	The effect on weeds of herbicide incorporated in fertilizer applied in spring	E, 5, 7, 8, 11
10.4/2	Herbicide, fertilizer, time, weed control	Grass	The effect on weeds of herbicide incorporated in fertilizer applied in autumn and spring	E, 5, 7, 8, 11
10.4/3	Herbicide, N top dressing ,weed control	Spring wheat	Herbicide incorporated in fertilizer as a top dressing for weed control	E, 2, 3, 8, 11
10.8/1	Tecane, fertilizer, wild oat control	Sugarbeet	Tecane incorporated in fertilizer for control of wild oats	E, 1, 6, 7
10.8/2	Tecane, fertilizer, phytotoxicity	Selection of crops	The effect of tecane incorporated in fertilizer when applied to a variety of crops	E, 1, 2, 3, 5, 6, 7, 8, 9, 11
10.8/3	Tecane/Aldrin, relationship	(a) Potato (b) Sugarbeet	The effect on health and yield of crops	L L
10.8/4	Aldrin/Tecane, relationship	(a) Potato (b) Sugarbeet	The effect on health and yield of crops	L L
12.1/3	K rate, source, tuber quality	Potato	Muriate and sulphate of potash; quality and yield of tubers	L, E, 3, 9, 11
12.1/4	NPK rate, tuber quality	Potato	The interaction of these nutrients on quality and yield of tubers	2
12.2/1	NK source, lime, F.Y.M., tuber quality	Potato	The effect of fertilizer source, lime and organic matter on quality and yield of tubers	1
16.1/1	Sampling technique	Kale	Improving crop sampling methods	L
16.5/1	Plot size	Potato Sugarbeet Swede	Statistical examination of results from a variety of plot sizes	All
16.5/2	Plot size	Grass	Statistical examination of results from two plot sizes	All
16.5/3	Plot size	Cereals	Statistical examination of results from two plot sizes and method of harvesting	L

Code No.	Title	Crop	Subject under investigation	Locations where sited
16.6/1	Harvesting technique	Cereals	Statistical examination of a number of harvesting methods	L
16.7/1	Sampling technique	Soil	Examining differences in soil composition in relation to method of applying fertilizer	L

Horticultural Field and Pot Experiments

The 1958 horticultural programme consists of seventy-five experiments with 2,985 plots. The fruit experiments are concerned mainly with plant establishment and with nitrogen, phosphate and potash nutrition. In glasshouse investigations on tomatoes, cucumbers and carnations, the main interests are the effects of various sources of nitrogen, rates of application of nitrogen, phosphate and potash, and liquid fertilizers. Vegetable experiments study sources of nitrogen, and fertilizers as carriers of insecticides. The turf programme covers sward production, nitrogen, phosphate and potash requirements of turf, and weed eradication.

Key to Locations

L	Levington
W	North Wyke
E	East Anglian counties
12	Western counties
13	Eastern counties
14	Southern counties

Code No.	Title	Crop	Subject under investigation	Locations where sited
FRUIT				
F 1.1/1	N source	Strawberry	N nutrition and a comparison of organic and inorganic sources	L
F 1.4/1	N and P source	Strawberry	The value of various organic and inorganic sources of nitrogen and phosphate, and of applied magnesium	L
F 1.4/2	N and P source	Blackcurrant	The value of various organic and inorganic sources of nitrogen and phosphate, and of applied magnesium and trace elements	L

Code No.	Title	Crop	Subject under investigation	Locations where sited
F 1.7/1	NPK rates and time of application	Strawberry	Fertilizer rates and time of application in relation to flowering, fruiting, disease incidence and tissue composition	L
F 1.7/2	NPK rates and time of application	Blackcurrant	Fertilizer rates and time of application in relation to flowering, fruiting, disease incidence and tissue composition	L
F 1.7/3	NPK rates and time of application (2)	Strawberry	Fertilizer rates and time of application in relation to flowering, fruiting, disease incidence and tissue composition	L
F 2.9/1	Chelated iron and the correction of iron deficiency	(a) Apple (b) Blackcurrant (c) Pear (d) Plum (e) Plum	The correction of iron deficiency by soil application of chelated iron (residual)	12 13 12 12 14
F 2.9/2	Chelated iron and the correction of iron deficiency	Apple	The correction of iron deficiency by soil and foliar applications of chelated iron	13
F 2.14/1	Nutrient deficiencies	Blackcurrant	Deficiencies of nitrogen, phosphate potash, magnesium and trace elements	L
F 2.14/2	Nutrient deficiencies	Culinary Apple	Deficiencies of nitrogen, phosphate, potash, magnesium and trace elements	L
F 2.14/3	Nutrient deficiencies	Dessert Apple	Deficiencies of nitrogen, phosphate, potash, magnesium and trace elements	L
F 2.14/4	Nutrient deficiencies	Pear	Deficiencies of nitrogen, phosphate, potash, magnesium and trace elements	L
F 5.5/1	Mulching and N requirement	Blackcurrant	Rates of application of nitrogen with and without straw mulch	L
F 6.6/1	Establishment	Blackcurrant	Four methods of establishment compared with standard technique	L
F 6.6/2	Establishment	Dessert Apple	Four methods of establishment compared with standard technique	L
F 6.6/3	Establishment	Pear	Four methods of establishment compared with standard technique	L
F 8.1/1	Mildew control	Apple	The effectiveness of fungicides as a control of mildew	13
F 10.10/1	Runner inhibition	Strawberry	The effect of a growth inhibitor on runner production	L

Code No.	Title	Code	Subject under investigation	Locations where sited
GLASSHOUSE CROPS				
G 1.1/1	N source	Tomato	A comparison of organic and inorganic sources of nitrogen	L
G 1.1/2	N source	Cucumber	A comparison of organic and inorganic sources of nitrogen	L
G 1.1/3	N source (2)	Tomato	The relative value of various organic nitrogen sources	L
G 1.1/4	N source (3)	Tomato	The relative value of various organic nitrogen sources	L
G 1.5/1	NK rate and N source	Carnation	The nitrogen and potash relationship in top dressings and the replacement of organic nitrogen sources by inorganic	L
G 1.7/1	NPK nutrition	Tomato	The relationship between nitrogen, phosphate and potash nutrition	L
G 2.6/1	pC values	Tomato	The effect of low (gypsum induced) pC values on growth	L
G 2.8/1	Liquid feeding	Tomato	Methods of using liquid fertilizers	L
G 2.8/2	Liquid feeding	Carnation	Methods of using liquid fertilizers	L
G 2.9/1	Foliar chlorosis	(a) Hydrangea (b) Primula	The correction of foliar chlorosis by soil application of chelated iron	L L
G 6.7/1	Growth behaviour	Tomato	To compare the growth characteristics of Syston Cross with Potentate	L
VEGETABLES, FLOWERS, ETC				
V 1.1/1	Residual effects of N source in base fertilizer	Mustard	The residual effect of various nitrogen sources after 1957 crops of autumn cabbage, summer lettuce and carrot	L
V 1.1/2	N rate, source and time	Anemone	The effect of various nitrogen sources and their rates and times of application	W
V 1.1/3	N source	Broccoli	The value of various organic nitrogen sources	L
V 1.7/1	NPK rate	Anemone	The nitrogen, phosphate and potash requirement of the anemone crop	W
V 2.22/1	Carbon black	Rose	The effect of soil applications of carbon black on growth	L
V 6.11/1	Irrigation; spray distribution pattern	—	The water distribution pattern from the Levington irrigation system	L

Code No.	Title	Crop	Subject under Investigation	Locations where sited
V 9.3/1	Combined fertilizer and insecticide	Summer Cabbage	The degree of insect control by insecticides incorporated in fertilizers, in the presence and absence of farmyard manure. Also to determine if phytotoxicity or taint occur	L
V 9.3/2	Combined fertilizer and insecticide	Carrot	The degree of insect control by insecticides incorporated in fertilizers, and to determine if phytotoxicity or taint occur	L
V 10.2/1	Perennial weed control	Weeds	The value of herbicides as spot treatment	E
FINE TURF				
T 1.1/1	N source	Turf	To observe the effect of various organic and inorganic sources of nitrogen applied in 1957	E
T 1.1/2	N source, establishment	Turf	The effect of various organic and inorganic sources of nitrogen on establishment	L
T 1.1/3	N source and rate	Turf	The effect of source and rate of nitrogen over a long period	L
T 1.1/4	Lawn conditioner	Turf	The effect of various lawn conditioner formulations	L
T 1.1/5	Golden Vigoro	Turf	The effect of Golden Vigoro on growth and colour	L
T 1.1/6	N source	Turf	The value of different types of urea-formaldehyde when applied in spring	L
T 1.1/7	Lawn conditioner	Turf	The long-term effect of spring application of various lawn conditioner formulations	L
T 1.4/1	P rate and source	Turf	The effect of various rates and sources of phosphate	L
T 1.6/1	PK rate and time	Turf	The effect of rate and time of application of phosphate and potash on growth, botanical composition and incidence of disease	L
T 1.7/1	NPK rate	Turf	The effect of various rates of nitrogen, phosphate and potash on growth, botanical composition and incidence of disease	L
T 1.7/2	NPK rate	Annual Meadow Grass	The effect of various rates of nitrogen, phosphate and potash on persistence	L

Code No.	Title	Crop	Subject under investigation	Locations where sited
T 8.6/1	Corticium and fusarium control	Turf	Degree of control obtained with various compounds	L
T 10.1/1	Copperas in lawn fertilizer	Turf	The effect of copperas on turf colour	L
T 10.1/2	Moss control	Turf	The properties of lawn sands containing different grades of copperas as moss eradicants	E
T 10.2/1	Herbicide	Turf	The use of a selective weedkiller on fine turf containing clover	L
T 10.2/2	Herbicides	Turf	The effect of selective weedkiller on grass seed germination when used prior to sowing	L
T 10.2/3	Herbicides	Turf	Herbicide and weed control	L
T 10.2/4	Herbicides	Lettuce	The effect of grass mowings from turf treated with selective weedkillers when used as a mulch	L
T 10.2/5	Herbicides	Turf	The use of selective herbicides on turf containing clover	L
T 10.2/6	Herbicides	Turf	The effect of herbicides on a wide range of weed species	E
T 10.2/7	Herbicides	Turf	The degree of control of pearlwort by various selective weedkillers	E
T 10.7/1	Evergreen and moss control	Turf	The degree of moss control obtained with a range of chemicals incorporated into a combined fertilizer and weedkiller	E
T 10.7/2	Moss eradication	Turf	The effect of a range of chemicals on the incidence of moss	E
T 10.7/3	Moss eradication	Turf	Chemicals for the control of moss	E
T 10.7/4	Moss eradication	Turf	The effect of a range of chemicals on the incidence of moss	E
T 10.9/1	Herbicide, established turf	Turf	The effect of methyl sec-butyl-urea on annual meadow grass in a fine turf sward	L
T 10.9/2	Herbicide, annual meadow grass	Turf	The effect of methyl sec-butyl-urea on the establishment of a fine turf sward	L
T 10.10/1	Growth inhibitors	Turf	The effect of growth inhibitors on fine grasses	L

Pot Experiments

The 1958 programme of experiments in the Pot Trials Unit includes (a) a further examination of water-soluble and citric-soluble phosphates, (b) the agronomic value of serpentine superphosphate and phospal, (c) boron deficiency and effective means of correcting it, (d) long-term effects of ureaformaldehydes and the effect of soil pH on the nitrogen availability from such sources, (e) lupin nutrition, (f) metal chelates for correcting soil deficiencies, (g) particle size of slag.

In addition to the agronomic experiments, accommodation and assistance will be provided for the pot experiments in connection with the work of the various fundamental research sections.

Code No.	Title	Crop	Subject under investigation
Agronomic Projects			
P 1.1/3	N nutrition	Mustard	The availability of nitrogen from various organic sources – short-term effect
P 1.1/4	N nutrition	Ryegrass	The availability of nitrogen from various organic sources – long-term effect
P 1.2/1	P nutrition	Oats	The agronomic value of serpentine superphosphate and phospal
P 1.2/2	P nutrition	Barley	The agronomic value of water and citric soluble phosphates
P 2.5/1	Boron nutrition	Broad bean Red clover Sugarbeet	The establishment of boron deficiency under pot experimental conditions for future investigations
P 2.9/1	Iron nutrition	Oats	The value of chelated iron in correcting iron deficiency in a variety of soils
P 2.9/2	Manganese nutrition	Oats	The value of chelated manganese in correcting manganese deficiency in a variety of soils
P 2.12/1	Particle size, basic slag	Grass	The agronomic value of basic slag ground to various particle sizes
P 2.16/1	N nutrition	Ryegrass	The effect of soil pH on the release of nitrogen from ureaformaldehydes
P 2.19/1	N nutrition	Barley Tomato	The toxicity of biuret and cyanates

Code No.	Title	Crop	Subject under investigation
P 6.6/1	Crop establishment	Lupin	The establishment of lupin in Levington soil
P 10.8/1	Weed control	Wild oat	The effectiveness of fertilizer plus tecane as a pre-emergent herbicide after a prolonged period of storage
P 16.4/1	Technique	Various	The optimum nutrient level in pot experiments
Basic Research Projects			
P 53.4/1-2	L-value in soils	Ryegrass	The change in L-value with time of soils which have received very high applications of superphosphate under field conditions
P 53.4/3	L-value and P source	Ryegrass	The influence on soil L-value assessment of form of labelled phosphate
P 100.2/1	NK nutrition	Potato	Nitrogen and potash in relation to plant growth and chemical composition at intervals
P 100.6/1	Technique	Pea	The optimum level of P^{32} tolerated by pea seeds and seedlings
P 100.9/2	P nutrition	Potato	Phosphate in relation to plant growth and chemical composition at intervals
P 101.3/1	P nutrition	Pea	The fate of luxury amounts of phosphate in the plant
P 110.2/9 -10	Technique	Pea	Production of plant material containing P^{32}
P 113.1/7	P^{32} and P absorption	Ryegrass	The influence of P^{32} level on the absorption of phosphate by plants

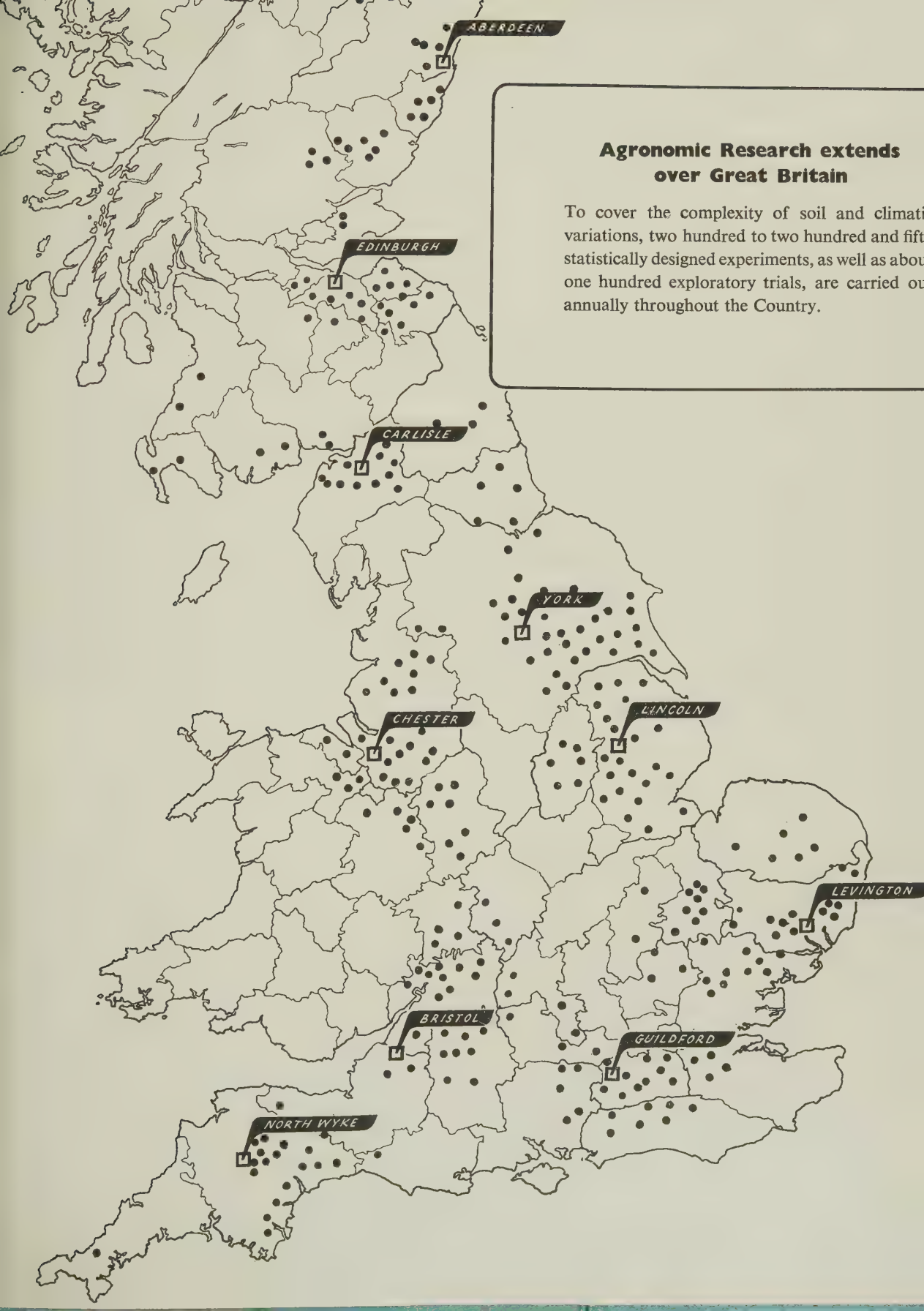
The field experiments in the provinces are designed and initiated at Levington Research Station and supervised by the following Agricultural Advisers, each responsible for one of the locations into which the Country is divided.

Location			
1	Aberdeen	J. M. Coull, Fisons Limited, The Ice Rink, South Anderson Drive, Aberdeen.	*Aberdeen 33323*
2	Edinburgh	H. P. Henderson, Fisons Limited, 49 North Castle Street, Edinburgh.	*Edinburgh 34344*
3	Carlisle	W. K. Letheren, The Poplars, Houghton, Carlisle, Cumberland.	*Carlisle 23155*
5	Chester	I. R. English, Felbridge, Chester Road, Sandiway, Cheshire.	*Sandiway 2162*
6	York	W. A. G. Mason, Fisons Limited, Harvest House, York.	*York 54575*
7	Lincoln	F. W. Dunnett, Fisons Limited, Harvest House, Carholme Road, Lincoln.	*Lincoln 11112*
8	Bristol	J. D. Edward, Fisons Limited, 11-19 Wine Street, Bristol.	*Bristol 27191/4*
9	North Wyke	P. G. Shaw, Downside, Whitchurch, Tavistock, Devon.	*Tavistock 3161*
11	Guildford	K. C. Morrison, Hillside, Lynwick Street, Rudgwick, Sussex.	*Rudgwick 268*
E	Levington	A. M. Ainsley, Levington Research Station, Levington, Ipswich, Suffolk.	*Ipswich 76911*

The Levington Horticultural Advisers located in the provinces are:

Western Counties	C. P. Quarrell, 2 Northwick Close, Worcester.	*Foregate 634*
Southern Counties	R. F. Clements, 'Pomona', 280 Lower Road, Great Bookham, Surrey.	*Bookham 3568*

Other areas are served from Levington Research Station.



Agronomic Research extends over Great Britain

To cover the complexity of soil and climati variations, two hundred to two hundred and fift statistically designed experiments, as well as abou one hundred exploratory trials, are carried ou annually throughout the Country.

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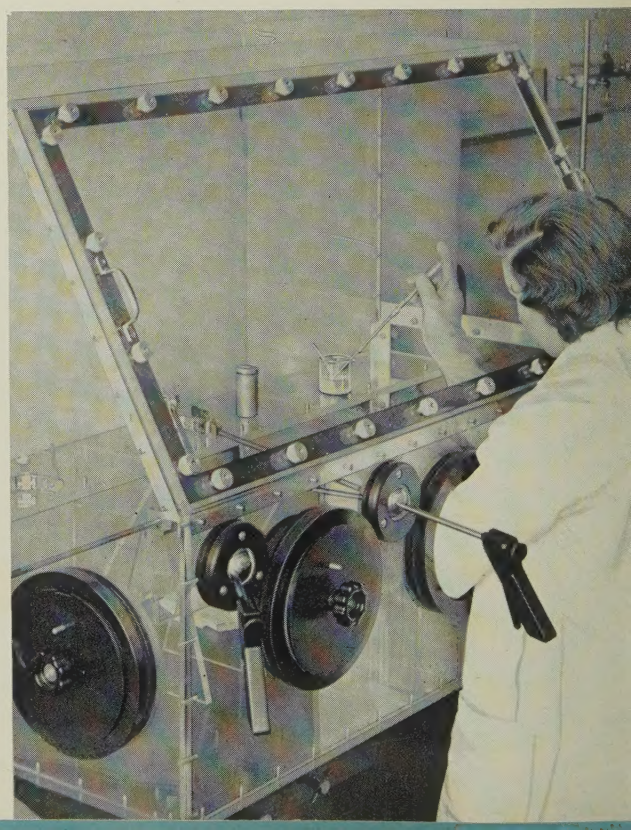
Above: The laboratory of the Chemistry Department, Levington exemplifies the general structural design and facilities.

Below: The Pot Trials Unit glasshouses are designed for maximum light and efficient temperature control. In this instance movable benches support the pots which are set in moistened sand to supply water to the plants by upward absorption.

Above: At Levington there are eighty-two agricultural and horticultural field experiments containing over 4,000 plots which are managed by Field Experimental Officers and Recorders. Determination of yields and representative sampling of herbage from plots are illustrated.

Below: Detailed investigations are important. In situ pH determination is illustrated.

Below: Radioactive phosphorus is one of the main tools in soil research and must be handled in a protective 'glove box'.



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